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It is proposed to restrict the present paper to the question of the chemical examination of the contents of the stomach. It is not only in cases of carcinoma or other severe organic lesion of the organ that investigations of its contents are of value; in those widespread lesser ailments which are vaguely grouped together as Dyspepsia, the condition of the gastric contents forms an even more important subject of study. It is to be regretted that such examinations are so seldom carried out. The difficulty of deciding when to prescribe alkalies, and when acids, might be lessened if the nature of the gastric juice were first investigated in each individual patient. In many cases a normal juice would be found; in these neither alkalies nor acids might be needed, and treatment would be directed to cleansing or replacing the teeth, modifying the diet and the patient's general mode of life, stimulating the muscular wall of the stomach, or regulating the action of the bowels. In others an excess of free hydrochloric acid will be found, and treatment by alkalies and perhaps an increased proteid diet indicated. In some of this class the acid would be in excess as early as half an hour after food, in others not until an hour or more later, and the application of a few easy tests would decide the best time for administering the alkali. In other people there would be deficiency of hydrochloric acid, or the gastric juice might even be quite alkaline, so that mineral acid must be artificially supplied, to some in small, to others in larger doses. The stomach might be found to contain food long after it should have emptied itself; drugs such as nux vomica would then be indicated, in order to stimulate the non-striped muscle of its walls. The pepsin of the gastric juice is less often defective than is the amount of acid; but occasionally it is found wanting, and then its place may be supplied by artificial pepsin, or the

need for it diminished by restricting the proteïd portion of the diet. Without examination of the secretion of the stomach, to determine first whether it be healthy or not ; and secondly, if found unhealthy, to determine in what respect the departure from health has taken place ; the treatment of dyspepsia must surely be haphazard and uncertain.

#### METHODS OF OBTAINING AND TESTING GASTRIC CONTENTS.

There are two main difficulties in carrying out such examination. The first—the less important of the two—is that the medical man has not the time for it, or to be more accurate, it is not so much that he has not the time, as that he has not the reägents and the apparatus ready. Were these to hand, the chief points could well be tested for in less than a quarter of an hour. The essential apparatus is a spirit-lamp, a metal dish for boiling water in, a few small evaporating basins, a funnel, some fine muslin, test-tubes, and litmus-paper. The essential test-solutions are Congo red, Günsberg's reägent, and Uffelmann's reägent ; these and one or two alternative tests are described below.

The second difficulty is that gastric contents are not readily obtainable in private practice. This is the more serious obstacle. A patient suffering from a dilated stomach or from gastric carcinoma vomits spontaneously, with the result that the vomit is usually tested in such cases. A patient who has dyspepsia may never vomit, so that artificial means must be employed to provide the fluid to be examined. Unless the patient suffered very greatly, the proposal to use the uncomfortable stomach-tube would often be refused. Not many persons, on the other hand, who had endured the discomforts of dyspepsia for any length of time, would object to an emetic, if they understood the object with which it was given. Thirty grains of zinc sulphate may be administered for the purpose, and the stomach-contents easily obtained.

Provided it be known exactly what food has been taken last, there is no real necessity to give a "test" meal. Some foods take longer than others to be digested, and therefore, according to the character of the meal, so will the time vary for the gastric juice to reach its point of greatest activity. After

proteid food a longer time elapses before free hydrochloric acid can be detected than after carbohydrate or fat, because the acid first secreted becomes loosely attached to proteid molecules as "combined" hydrochloric acid, and it is only after the proteid has been satisfied in this way that a surplus can be detected as "free" acid. The average time required for this process is three-quarters of an hour, and in the meanwhile the starch-digesting ferment of the saliva continues its activity in the stomach. When gastric digestion has reached its height, there should be 0·2 per cent. of free hydrochloric acid. This point is attained earlier when carbohydrates alone have been eaten, later when proteids have been taken too; so that it is usually convenient to give a "test" meal of known composition, and to administer the emetic at a definite interval afterwards. The following are examples of test-meals, and the times given for recovering them are those at which the gastric juice should have the full characters of health:—

Ewald's breakfast. 8 o'clock:—

White bread - - 70 grammes.

Weak tea - - 300 cc.

Empty the stomach in 1 hour.

Klemperer's breakfast. 8 o'clock:—

White bread - - 70 grammes.

Milk - - 500 cc.

Empty the stomach in 2 hours.

Germain See's lunch. 11 o'clock:—

White bread - - 150 grammes.

Minced meat - - 80 grammes.

Cold water - - 300 cc.

Empty the stomach in 2 hours.

Riegel's dinner. 2 o'clock:—

Soup - - 100 cc.

Beef-steak - - 60 grammes.

White bread - - 50 grammes.

Empty the stomach in 5 hours.

In practice Ewald's breakfast is the most serviceable; and there is no objection to toasting the bread, or to putting a little butter on it.



## EXAMINATION FOR HYDROCHLORIC ACID.

Having obtained the vomit, the chief point to examine is, as a rule, its acidity. First strain out the particles of undigested food by throwing the whole on to a piece of muslin supported in an ordinary funnel. It is not advisable to use filter-papers for this purpose, because there are at least four factors which go to make up the total acidity, namely :—

1. Acid salts, chiefly acid sodium phosphate ;
2. " Combined " hydrochloric acid ;
3. Organic acids, chiefly lactic, with traces of acetic and butyric ;
4. " Free " hydrochloric acid ;

and it is found that filter-papers allow some of these to pass through more rapidly than others, with the result that the filtrate has a different acidity to that of the original vomit.

Next test with neutral litmus-paper ; reddening of the latter will indicate acidity, but will not show to which of the above four factors this acidity is due. Acid salts or "combined" hydrochloric acid redden litmus-paper as readily as do organic or "free" mineral acids. If, however, the test-paper be not reddened, then a pathological condition is at once found, namely, the existence of a neutral or alkaline medium, in which pepsin is unable to digest proteïd.

If the litmus-test be positive, next test with Congo red. The solution is made up as follows :—

Congo red	-	-	-	0·1 gramme,
Water	-	-	-	100 c.c.,

and it is convenient to make test-papers by dipping filter-paper into the solution, allowing it to dry, cutting it into strips, and storing these ready for use. Pour a drop of the strained vomit on to one of the red strips, hold it up to the light, and observe if any change of colour has occurred. Acid salts and "combined" hydrochloric acid will produce no change ; weak solutions of lactic acid will darken the Congo red to a deep brown ; strong lactic acid, or dilute free hydrochloric acid, will turn it a deep blue.

Should the Congo-red test indicate the presence of free acid, one or other of the following tests for free hydrochloric acid may be employed :—

*Günsberg's Test.*—The reagent is made up as follows :—

Phloroglucin	-	-	-	2 grammes.
Vanillin	-	-	-	1 gramme.
Rectified spirit	-	-	-	100 c.c.

The bottle in which it is kept should be well stoppered, and is best stored away from bright daylight. The solution keeps good for many weeks, but slowly loses its delicacy as a test, so that fresh quantities must be made from time to time. One of the best ways of applying the test is as follows :—Boil some water in a shallow pan, to serve as a water-bath ; float a clean dry porcelain evaporating-dish upon the water, and into the dish put *three drops* of Günsberg's reagent and *three drops* of the strained gastric contents ; as the mixture slowly dries it assumes a beautiful rose-red colour, first around the edges and finally all over the dried residue, if free hydrochloric acid be present. Further heating causes this rose-red colour to disappear again, but if the dish be taken off the water-bath and cooled, the colour will remain for several hours. There are three chief sources of error to avoid in performing the test, and unless attention be paid to them free hydrochloric acid may be missed. The first is overheating ; to avoid this the water-bath is used ; application of a flame directly to the evaporating dish often causes the contents to char without giving the pink colour. The second is using too large a bulk either of the reagent or of the strained vomit ; three drops of each are plenty. The third is using unstrained vomit ; the presence of solid particles of food will often vitiate the test, apparently because the heated hydrochloric acid is used up in acting upon this food rather than upon the phloroglucin and vanillin.

The test properly applied is very easy ; it takes but a few minutes, and is very delicate. A similar rose-red colour is given with any free inorganic acid, such as nitric acid or sulphuric ; it is also given with *strong* solutions of organic acids, such as acetic or lactic. Unless the patient have just swallowed a quantity of vinegar, for example, there is never sufficient organic acid in a vomit to give the test ; nor is any other mineral acid than hydrochloric likely to be present ; the rose-red colour is not given by “combined” hydrochloric acid ; therefore Günsberg's is one of the best tests for the free acid. Moreover, the depth of the rose-red colour is

greater the more free hydrochloric acid there is present, so that, if exactly three drops both of strained vomit and of the test solution be always used, the resulting colour affords an approximate idea as to whether the amount of free acid is deficient, normal, or excessive.

The following are alternative tests, which may be used either in addition to, or in place of, Günsberg's :—

*Boas' Test.*—The reagent is made up as follows :—

Resorcin	-	-	-	5 grammes.
White sugar	-	-	-	3 grammes.
Rectified spirit	-	-	-	100 c.c.

It is more stable than Günsberg's solution, and is also cheaper. The test is performed in exactly the same way as Günsberg's, using an evaporating-basin on a water-bath, three drops of reagent, three drops of strained vomit, and watching for a rose-red colour in the residue as it dries. The disadvantage of the test is that the red colour appears more slowly. Often the test seems to be giving a negative result, when warming the dried residue for another ten minutes will bring out the characteristic rose-red. To a busy man this is a very real objection. In other respects the test is very similar to Günsberg's.

*The Tropæolin test.*—The reagent is made up as follows :—

Methyl orange	-	-	-	0.2 gramme.
Rectified spirit	-	-	-	25 c.c.
Distilled water to	-	-	-	100 c.c.

The solution keeps good indefinitely, even in broad daylight. To perform the test, place one drop of the solution upon a white porcelain slab, spread it out in a thin layer over an area about equal to that of a penny, and dry it at 40° C. If there be a Bunsen flame available, this may be done by placing the slab upon the bench close to the foot of the burner; if a spirit-flame be used, the slab may be directly warmed until it feels to be about body-temperature. When the tropæolin has dried, put a single drop of the strained vomit upon the centre of the yellow stain; if free hydrochloric acid be present, a beautiful violet colour appears, and becomes intensified as the fluid dries again at body-temperature. It is a very easy and pretty test; but if a considerable quantity of lactic acid be



present, it will give the colour too. Seldom, however, is sufficient lactic acid present in the gastric contents to give the reaction, so that the test is usually held to be good proof of the presence of free hydrochloric acid.

*The Methyl-Violet Test.*—The solution is made up as follows :—

Methyl violet	-	-	-	0·1	gramme.
Distilled water	-	-	-	100	c.c.

The reagent keeps well. It is an easy test, and is applied thus : One drop of the methyl violet is placed upon a white porcelain surface, and close to it one drop of the strained vomit. The two drops are made to coalesce, and the colour watched at the point where they mix. A change from violet to greenish-blue occurs if free hydrochloric acid be present, but there are some conditions in which sufficient lactic acid may be present to produce a similar change.

#### TEST FOR LACTIC ACID.

The test employed for detecting lactic acid is known as *Uffelmann's*. The solution required is best made fresh each time by adding a few drops of liquor ferri perchloridi to half a test-tubeful of carbolic acid (1 in 20). A purple-blue colour results. On adding the strained vomit to an inch of this in a test-tube the blue colour disappears, and if lactic acid be present, the liquid becomes canary-yellow. If free hydrochloric, but no lactic acid be present, the blue colour is discharged entirely, the resulting liquid being colourless ; but not infrequently a doubt as to the colour arises, because a precipitate of phosphates comes down. It is the *solution* which must be canary-yellow to indicate presence of lactic acid ; therefore in all cases the mixture of Uffelmann's reagent and of strained vomit must be filtered, and the colour of the *filtrate* observed. The importance of filtering will be at once seen if, to a little Uffelmann's reagent in a test-tube, some ammonia-solution be added ; a bright-yellow colour replaces the blue, but, on filtering, the filtrate is colourless ; all the yellow colour in this case is in a very fine flocculent precipitate. It must also be remembered that there is a certain yellowness about the strained vomit itself, so that the filtrate which results from Uffelmann's test

must be yellower than the original stomach-contents before lactic acid can be said to be present.

It may be well here to summarise shortly the steps to be employed in testing the acidity of gastric juice :—

- (a) First strain the vomit through fine muslin, and not through filter-paper.
- (b) Test with neutral litmus-paper ; a red reaction indicates acidity due to one or more of the following : (1) acid sodium phosphate ; (2) combined hydrochloric acid ; (3) lactic acid ; (4) free hydrochloric acid.
- (c) Test with Congo red ; a blue reaction indicates lactic acid or free hydrochloric acid ; a brown reaction is indeterminate ; neither acid sodium phosphate nor combined hydrochloric acid alter the red colour at all.
- (d) Test with Günsberg's reagent ; a rose-red colour indicates free hydrochloric acid ; this is the most satisfactory test for the purpose, though Boas' test, the tropæolin test, or the methyl-violet test, may be employed as alternatives.
- (e) Test with Uffelmann's reagent ; a light-yellow colour of the filtrate indicates lactic acid.

In regard to the interpretation of the results found, stress has already been laid upon the importance of knowing how long previously the last food was taken, and what proportion of proteid it contained. Absence of free hydrochloric acid for three-quarters of an hour after food is physiological. If a test-meal has been given, and recovered in the prescribed time, Günsberg's test should readily give a fine rose-red reaction. If this be not so, either an attempt should be made to supply free hydrochloric acid by the mouth ; or the proteid portion of the diet should be very finely divided before it is swallowed. The stomach is loth to allow large solid particles to pass through the pylorus, and yet it cannot, in the absence of free hydrochloric acid, disintegrate pieces of solid meat. If, on the other hand, Günsberg's test show that free hydrochloric acid appears too early—that is to say, within three-quarters of an hour after a meal—the action of the starch-dissolving ferment of swallowed saliva is checked too soon, and the carbohydrates, which the gastric juice cannot digest, remain as offending solid lumps. Attempts should be made to prevent the appearance of free

hydrochloric acid quite so soon by giving sodium carbonate, or other alkali, at a period of 10, 15, 20, 25, 30 or 35 minutes after food, according to the time at which the free acid is first present. The same end may be to some extent attained by giving more proteïd at meal-times ; such additional proteïd must first be satisfied before any surplus hydrochloric acid will be "free." There are two factors which limit the latter form of treatment ; the first is, that proteïd food more than any other stimulates the stomach to increase the secretion of its juice ; and the second is that the kidneys may suffer if too much work be thrown upon them in the elimination of nitrogenous waste products.

Free hydrochloric acid may not appear unduly soon, and yet it may continue to be secreted to an abnormal extent. Instead of reaching 0·2 per cent. and not increasing further, it may rise to as much as 0·3 per cent. or 0·4 per cent., in cases of hyperacidity and gastric ulcer. Perhaps the hyperacidity is one factor in the production of gastric ulcer ; the frequent association of the two conditions is suggestive. Even if this be not so, it is desirable to check such hyperacidity if possible, and only by examination of the gastric contents can this be done methodically. The depth of the rose-red colour given by Günsberg's test affords a means of judging when free hydrochloric acid is present in excess. This will not be immediately after a meal ; and the time when hyperacidity begins will vary in different people. In some an alkali will be indicated one hour after meals, in others an hour and a half after, in others two hours, and so on, examination of the gastric contents affording the ideal criterion in each individual patient.

#### DIAGNOSTIC VALUE OF THE EXAMINATION.

In the present paper examination for free acid is urged chiefly from the point of view of treatment. It is also said to have a diagnostic value ; in cases, for example, of gastric carcinoma much stress is often laid upon the absence of free hydrochloric acid. The writer is more than doubtful of the value of this as a diagnostic test. In the first place the site of a stomach-cancer does not usually coïncide with that of the oxyntic cells ; the latter are in the cardiac portion of the stomach, the former usually at the pylorus. In the second

there are a very large number of conditions in which, time and again, absence of free hydrochloric acid from the stomach-contents has been demonstrated. In many febrile conditions this may be so ; for instance, in patients suffering from enteric fever or from influenza. In chronic congestion of the stomach it is sometimes so (for example, in patients suffering from failing heart) ; sometimes in Bright's disease, again, and in many cachectic conditions. Indeed, in those cases of gastric carcinoma in which free hydrochloric acid has been absent, it seems not improbable that the cancer may have caused cachexia, and that the cachexia rather than the locality of the growth has been the immediate cause of the deficiency in acid. Free hydrochloric acid has been present in more than one case of gastric carcinoma, and many a sick patient who has no cancer of the stomach is found to have no free hydrochloric acid in the vomit. With ill-health all the tissues and secretions of the body suffer, and amongst them the gastric juice. Bearing in mind that gastric ulcer is often associated with hyperacidity, it may be allowed, perhaps, that when the diagnosis lies solely between that of gastric ulcer and that of gastric growth, great deficiency or absence of free hydrochloric acid is in favour of the latter, whilst hyperacidity is in favour of the former ; even in such cases, however, the diagnostic value of the test is much restricted, for in many the free acid is neither absent nor in excess.

The following are the results obtained on testing a large number of consecutive vomits in the wards, taken indiscriminately. The chief lesson to be learned from them is that, when a patient is really ill, the gastric secretion is unfit for heavy work, and the diet must be of the simplest. This is not likely to be forgotten when the patient has a fever, but in cases such as heart-disease with signs of failure it is more likely to be overlooked. An overloaded stomach is not infrequently the direct cause of death in such cases.

#### RESULTS FOUND ON TESTING THE VOMIT OF 38 PATIENTS SUFFERING FROM VARIOUS DISEASES.

In all cases vomiting was more than three-quarters of an hour after food ; and the diet was either milk, or bread-and-butter and tea.



*Affections of the Stomach.*

No. of Case.	Diagnosis.	To Litmus.	To Congo Red.	To Uffelmann's Test.	To Günsberg's Test.	Lactic Acid.	Free Hydrochloric Acid.
1	Fibrous stricture of pylorus and dilated stomach.	Alkaline.	No.	No.	No.	No.	No.
2	Simple stricture of pylorus and dilated stomach.	Very acid.	Blue.	Canary-yellow.	No.	Excess.	No.
3	Old cicatrised ulcer; dilated stomach.	Acid.	Blue.	Pale-yellow.	Rose-red.	Present.	Present.
4	Simple dyspepsia -	Acid.	No.	No.	No.	No.	No.
5	Carcinoma of stomach	Acid.	Deep-brown.	Canary-yellow.	No.	Excess.	No.
6	Carcinoma of stomach	Very acid.	Blue.	No.	Rose-red.	No.	Present.
7	Carcinoma of stomach	Acid.	Deep-brown.	Canary-yellow.	No.	Excess.	No.
8	Carcinoma of stomach	Acid.	Blue.	No.	Rose-red.	No.	Present.

*Febrile Affections.*

9	Enteric fever, relapse -	Acid.	Blue.	No.	Rose-red.	No.	Present.
10	Enteric fever - -	Neutral.	No.	No.	No.	No.	No.
11	Enteric fever - -	Acid.	No.	No.	No.	No.	No.
12	Influenza - -	Acid.	No.	No.	No.	No.	No.

*Pulmonary Affections.*

13	Fibroid lung and bronchiectasis.	Acid.	Deep-brown.	Pale-yellow.	No.	Present.	No.
"	Do., another day	Strongly Acid.	Blue.	No.	Rose-red.	No.	Present.
14	Phthisis - - -	Acid.	Brown.	Pale-yellow.	No.	Present.	No.
15	Phthisis - - -	Acid.	No.	No.	No.	No.	No.
16	Bronchiectasis -	Acid.	Brown.	Canary-yellow.	No.	Excess.	No.
17	Phthisis; Spinal caries; lardaceous disease.	Neutral.	No.	No.	No.	No.	No.
18	Phthisis; lardaceous disease.	Neutral.	No.	No.	No.	No.	No.

*Nervous Affections.*

19	Myoclonus lumbalis et cervicalis.	Very acid.	Blue.	No.	Rose-red.	No.	Present.
20	Cerebral tumour, on several occasions.	Acid.	No.	No.	No.	No.	No.
"	Do., on one occasion	Alkaline.	No.	No.	No.	No.	No.
"	Do., on one occasion	Very acid.	Brown.	Canary-yellow.	No.	Present.	No.
"	Do., on one occasion	Very acid.	Blue.	Canary-yellow.	Rose-red.	Present.	Present.



*Heart-Affections.*

No. of Case.	Diagnosis.	To Litmus.	To Congo Red.	To Uffelmann's Test.	To Günsberg's Test.	Lactic Acid.	Free Hydrochloric Acid.
21	Aortic and mitral, with failure on seven different occasions.	Acid.	Brown.	Canary-yellow.	No.	Present.	No.
"	Do., on one occasion	Acid.	Blue.	Canary-yellow.	Light rose-red.	Present.	Present.
22	Heart failure - -	Strongly acid.	Brown, slight.	No.	No.	No.	No.
23	Aortic and mitral, almost compensated.	Strongly acid.	Brown.	Canary-yellow.	No.	Present.	No.
24	Valvular disease and failure.	Alkaline.	No.	No.	No.	No.	No.

*Various other Affections.*

25	Exophthalmic goitre -	Acid.	No.	No.	No.	No.	No.
26	Exophthalmic goitre -	Strongly acid.	Blue.	Canary-yellow.	Rose-red.	Present.	Present.
27	Perihepatitis and ascites.	Acid.	No.	No.	No.	No.	No.
28	Cirrhosis of liver, ascites, cholæmia.	Strongly acid.	Blue.	No.	Rose-red.	No.	Present.
29	Cirrhosis of liver -	Acid.	Blue.	No.	Rose-red.	No.	Present.
30	Acute tubal nephritis -	Just acid.	No.	No.	No.	No.	No.
31	Diabetes mellitus -	Acid.	Brown.	Light-yellow.	No.	Present.	No.
32	Tubercular peritonitis	Alkaline.	No.	No.	No.	No.	No.
33	Appendicitis - -	Alkaline.	No.	No.	No.	No.	No.
34	Appendicitis -	Acid.	No.	No.	No.	No.	No.
35	Carcinoma of cervix uteri and double pyonephrosis.	Very acid.	Blue.	Canary-yellow.	Rose-red.	Present.	Present.
36	Carcinoma of colon -	Acid.	No.	No.	No.	No.	No.

In regard to the lactic acid, this is a normal constituent of the gastric contents in the earlier stages of digestion. During the first three-quarters of an hour, before any free hydrochloric acid is present, the lactic acid increases rapidly in amount, particularly when the diet contains milk. When free hydrochloric acid appears, the formation of lactic acid diminishes and soon ceases; for a time both acids are present together; then the lactic acid disappears, so that at the height of digestion, with 0·2 per cent. of free hydrochloric acid, lactic acid can no longer be detected. It is therefore difficult, in most cases, to draw any conclusions from the lactic-acid test, unless there be something very much the matter. Absence of free

hydrochloric acid may allow much acid fermentation in the stomach, with production of an obvious excess of lactic acid. Acid dyspepsia is often of this nature. It may occur in any diseases in which free hydrochloric acid is absent, and amongst these in gastric carcinoma. It is not distinctive of any particular affection, but indicates the necessity of being careful with the diet, of assisting the pepsin by giving dilute mineral acids by the mouth, and perhaps of inhibiting the action of microorganisms by such drugs as glycerine of carbolic acid or sulphocarbonate of sodium.

#### QUANTITATIVE ESTIMATION OF ACIDITY.

In some cases it is important not only to test, but also to estimate, the acidity. As has been mentioned, the depth of rose-red colour with Günsberg's test affords a rough idea of the amount of free hydrochloric acid present; but in difficult cases of acid dyspepsia, or of gastric ulcer with hyperacidity, greater accuracy is needed. It is easy to estimate the total acidity, but less so the acidity due to free hydrochloric acid. In either case a decinormal soda-solution is required, and this is made by dissolving 4 grammes of fused caustic soda in distilled water up to 1,000 c.c.

To estimate the total acidity, 100 c.c. of the strained vomit may be measured into a beaker; 10 drops of phenol-phthaleïn solution added; and the beaker placed upon a white slab beneath a burette filled with decinormal soda-solution. The soda is added, a few drops at a time, until the yellow colour of the fluid in the beaker just changes to a definite light-pink. The volume of standard soda-solution required to do this contains the amount of caustic soda needed to neutralise all the acid salts, combined hydrochloric acid, lactic acid, and free hydrochloric acid in the 100 c.c. of vomit. The "acidity" of the latter may be expressed in terms of caustic soda, or a simple calculation will give it in terms of hydrochloric acid. It is best expressed in terms of caustic soda, because the total acidity is far from being all due to hydrochloric acid.

To estimate the proportion of the acidity that is due to free hydrochloric acid is not so simple. There are several methods for doing it accurately, but most are too complicated for clinical

use. The following gives very approximate results, and is simple, though it takes perhaps half an hour to carry out. Float six clean evaporating-basins upon the water-bath, and into each put two drops of Günsberg's reagent. Number them 1, 2, 3, 4, 5, and 6. Measure 100 c.c. of strained vomit into a beaker, and add 5 c.c. of decinormal soda-solution from the burette. Stir well, and transfer two drops of the contents of the beaker to the evaporating basin marked 1. Now add another 5 c.c. of decinormal soda-solution to the vomit in the beaker, stir well, and transfer two drops of the contents of the beaker to the evaporating-basin marked 2. Add another 5 c.c. of the soda to the beaker, stir, and transfer two drops to the basin marked 3; and so on. That is to say, after each addition of 5 c.c. of decinormal soda-solution to the 100 c.c. of vomit, do a Günsberg's test. Suppose evaporating-basins No. 1 and No. 2 give a good rose-red colour, whilst No. 3 gives a paler tint, No. 4 a very pale, and No. 5 none at all, it follows that 20 c.c. of decinormal soda-solution are just too little to neutralise all the free hydrochloric acid in the 100 c.c. of strained vomit, whilst 25 c.c. are just too much. Now repeat the process again; take four clean evaporating-basins to each of which two drops of Günsberg's reagent have been added; number them 1, 2, 3, and 4; float them on the water-bath; measure a fresh 100 c.c. of strained vomit into a beaker, add 21 c.c. of decinormal soda-solution, and put two drops of the beaker-contents into basin No. 1. Add another 1 c.c. of soda, and put two drops of the beaker-contents into basin No. 2; similarly with basins No. 3 and No. 4, after each addition of 1 c.c. of soda to the 100 c.c. of vomit. Suppose basin No. 1 give a faint pink colour, No. 2 a very faint tinge, and No. 3 none at all, it follows that 22 c.c. of decinormal soda-solution are just insufficient to neutralise all the free hydrochloric acid in 100 c.c. of strained vomit, whilst 23 c.c. are just too much; the mean between the two is the measure, in terms of caustic soda, of the acidity due to free hydrochloric acid.

If the total acidity be known, and also that due to free hydrochloric acid, the difference gives that due to acid sodium phosphate, to lactic acid, and to combined hydrochloric acid, together. There is no simple clinical method for estimating these separately.

## ESTIMATION OF PEPSIN.

It is sometimes important to test the activity of the peptic ferment, though this is less often defective than is the hydrochloric acid. For this purpose discs of hard-boiled white of egg may be prepared. Boil an egg for twenty minutes, allow it to get cold, and then peel the white from the yolk, cut the former into strips, and punch out discs with a cork-borer. These discs may be kept in glycerine ready for use. To apply the test, take four test-tubes, number them 1, 2, 3, and 4, put 5 c.c. of strained vomit and 1 disc of egg white into each, and stand them in a water-bath heated to body-temperature. Add nothing further to No. 1. To No. 2 add 2 grains of dried pepsin. To No. 3 add 2 drops of dilute hydrochloric acid (B.P.). To No. 4 add 2 drops of dilute hydrochloric acid and 2 grains of pepsin. Leave them for an hour, and then observe which of the tubes show solution of the discs. If No. 1 does so, the gastric juice contains active pepsin, and is sufficiently acid to allow of its digesting proteïd. If No. 1 does not, but No. 2 does, the gastric juice is suitable for peptic activity but is lacking in pepsin. If No. 1 and No. 2 do not, but No. 3 does, then the gastric juice contains pepsin, but too little hydrochloric acid to allow it to be active. If No. 1, No. 2, and No. 3 do not, whilst No. 4 does, then the gastric juice is deficient both in hydrochloric acid and in pepsin. Should pepsin be found wanting, its place may be artificially supplied by prescribing one of the preparations of this ferment.

## EXAMINATION FOR RENNIN.

In the gastric juice, particularly of children, another ferment, rennin, should be present. In its absence cow's milk is ill-digested, forming dense curdled masses in the stomach. It may readily be tested for as follows:—Neutralise 10 c.c. of strained vomit by adding two drops of phenol-phthalein as an indicator, and dilute caustic soda until a faint-pink colour appears; add 10 c.c. of fresh cow's milk, previously boiled and allowed to cool nearly to body-temperature. If rennin be present, the caseinogen of the milk will presently be precipitated in fine flakes. Should rennin be absent from the gastric contents, it will be necessary either to add barley or lime-water



to the milk to ensure a finer precipitate of casein in the stomach ; or to peptonise the milk before giving it ; or to give rennet in the form of curds and whey ; or even in some cases to replace the milk for the time being by some other food, such as albumen-water.

Estimations of acidity are rarely necessary in private practice ; testing the acidity and investigating the ferments are far more valuable. It is a pity that the tests are so seldom applied. To examine a vomit for the nature of its acidity occupies but little longer time than does the proper testing of a specimen of urine. It cannot but be that the treatment of dyspepsia would be more successful were an emetic administered to the patient after the object in view had been explained, and were the prescription based upon the indications given by the clinical examination of the gastric contents.

